Lessons Learned Workshop for PI-Led Planetary Science Missions

Project Management and Industry Perspectives & Discussion – an SwRI Perspective

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Presentation Topics

- Overview comments.

- Business office challenges and issues.

- Schedule management.

- Earned value.

- Requirements management.

PL-Led Mission Management

- SwRI experience with PI-Led missions includes SMEX (IBEX, Twins), MIDEX (IMAGE), and New Frontiers (New Horizons, Juno).

  – Experiences have been generally good, with a few exceptions and some special considerations.

  – Difficult to go back to the classic NASA-Led mission management structure after 10 consecutive years of working PI-Led missions.

- Management experiences with PI-Led planetary missions (New Horizons, Juno) is consistent with earlier experiences from SMEX and MIDEX.

  – PI and PM are responsible for all aspects of project performance.

  – PI's institutional business infrastructure will be taxed to the limit.

  – Successful management of the schedule is absolutely essential to mission success.

  – Procrastination is death – problems have to be dealt with the first time they appear.

  – Requirements management will prove more important than you thought it would when you write your proposal.

Special Issues w/PI-Led Mission Management

- Business office challenges can be overwhelming if not prepared.
  - You effectively serve as NASA – you are the funding source for all of your team members.
  - Extensive time is required for preparing subcontract statements of work, preparing RFP packages, evaluating subcontract proposals, developing integrated spend plans, and monitoring team member's performance.
    - An experienced subcontracts managers is essential.
    - As PM, you are responsible for managing the funding of all of your team members.
  - Cash flow can be especially difficult.
    - Even if you have not been funded, you still have to pay the invoices of your team members.
    - Negative cash flow can run into 100's of K or more on a monthly basis.
    - Commercial for-profit team members cannot wait for their funding, you must be prepared to function as the bank to carry the float on invoices.

Schedule Management

- Schedule management essential to mission success.
  - If you cannot control the schedule, you have no prayer of controlling cost.
  - You scheduling process has to be timely, accurate, and trusted.
    - System and subsystem suppliers have to "own" their schedules.
    - Scheduling process has to be capable of integrating schedules from a variety of software packages.
  - An integrated mission schedule has to be generated and reviewed monthly.
    - Schedule trends can be very revealing.
    - Schedule metrics do not need to be complicated to be useful for decision making and resource allocation.
  - The management team has to be seen by the project team to be serious and CONSISTENT about schedule performance.

Example Metric from New Horizons

System	Subsystem	Design			Fab			Test		
		BB	EM	FM	BB	EM	FM	BB	EM	FM
Telescope	Housing	■	▨	▨	■	▨	▨	■	■	■
	Mech. Comp.	■	▨	▨	■	▨	▨	■	■	▨
	SOC Door	▨	▨	▨	▨	▨	▨	▨	▨	6/4/04
Detector	MCP	▨	▨	▨	▨	▨	▨	▨	▨	▨
	Electronics	▨	▨	▨	▨	▨	▨	▨	▨	▨
	Packaging	▨	▨	▨	▨	▨	▨	▨	▨	▨
Power	HVP S	■	▨	▨	■	▨	▨	■	▨	▨
	LVPS	■	▨	▨	■	▨	▨	■	▨	▨
Controller	Hardware	■	▨	▨	■	▨	▨	■	▨	5/29
	Software	■	▨	▨	■	▨	▨	■	▨	6/2
EGSE	Hardware	■	▨	▨	■	▨	5/27/0	■	▨	5/24
	Software	■	▨	▨	■	▨	5/27/0	■	▨	5/27
MGSE		■	▨	▨	■	▨	▨	■	▨	6/23
Documen.	ICD	■	■	▨	■	■	■	■	■	■
	Spec.	■	■	▨	■	■	■	■	■	■
	TLM/CMD DB	■	■	▨	■	■	■	■	■	■

Instrument Development Status   - Alice

Legend: ▨ Complete   ▮ Problem   ▮ In Work   □ Not Started   ■ N/A
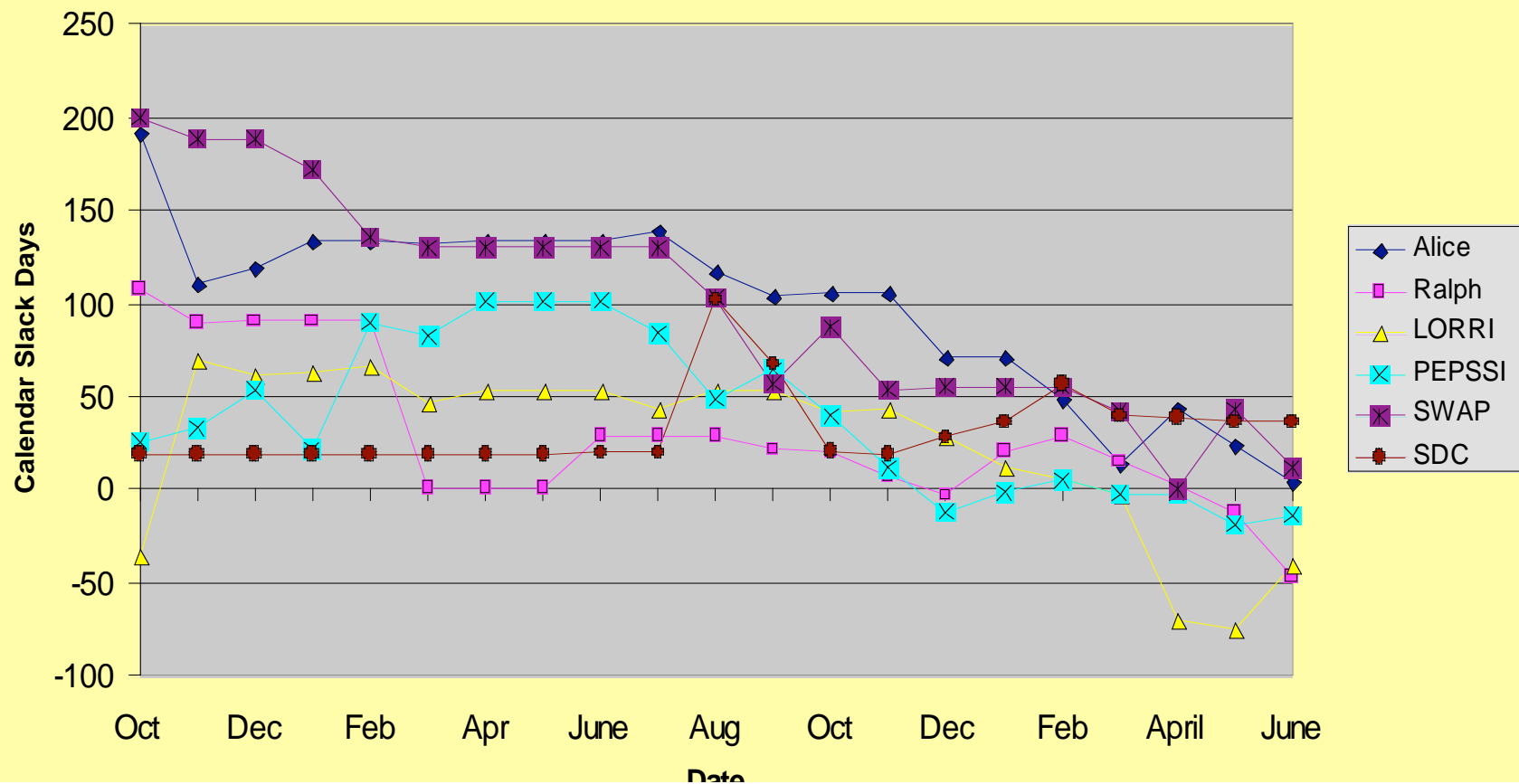
NH Payload Slack Summary Chart

Schedule Audits

- Schedule audits can be very helpful, especially in early days of the project.
  - In-plant audit of the work accomplished vs. the claim of accomplishment on the team's schedule.
  - Experience shows multiple types of findings from a typical schedule audit.
    - The actual schedule being used by the team has nothing to do with the schedule submitted to the PM.
    - The claim of progress made to date is exaggerated quite a bit.
    - The team is inexperienced in scheduling in general and does not know how to produce a useful schedule.
    - The team thinks scheduling is a waste of time and have invested little if any effort in developing or tracking a schedule.
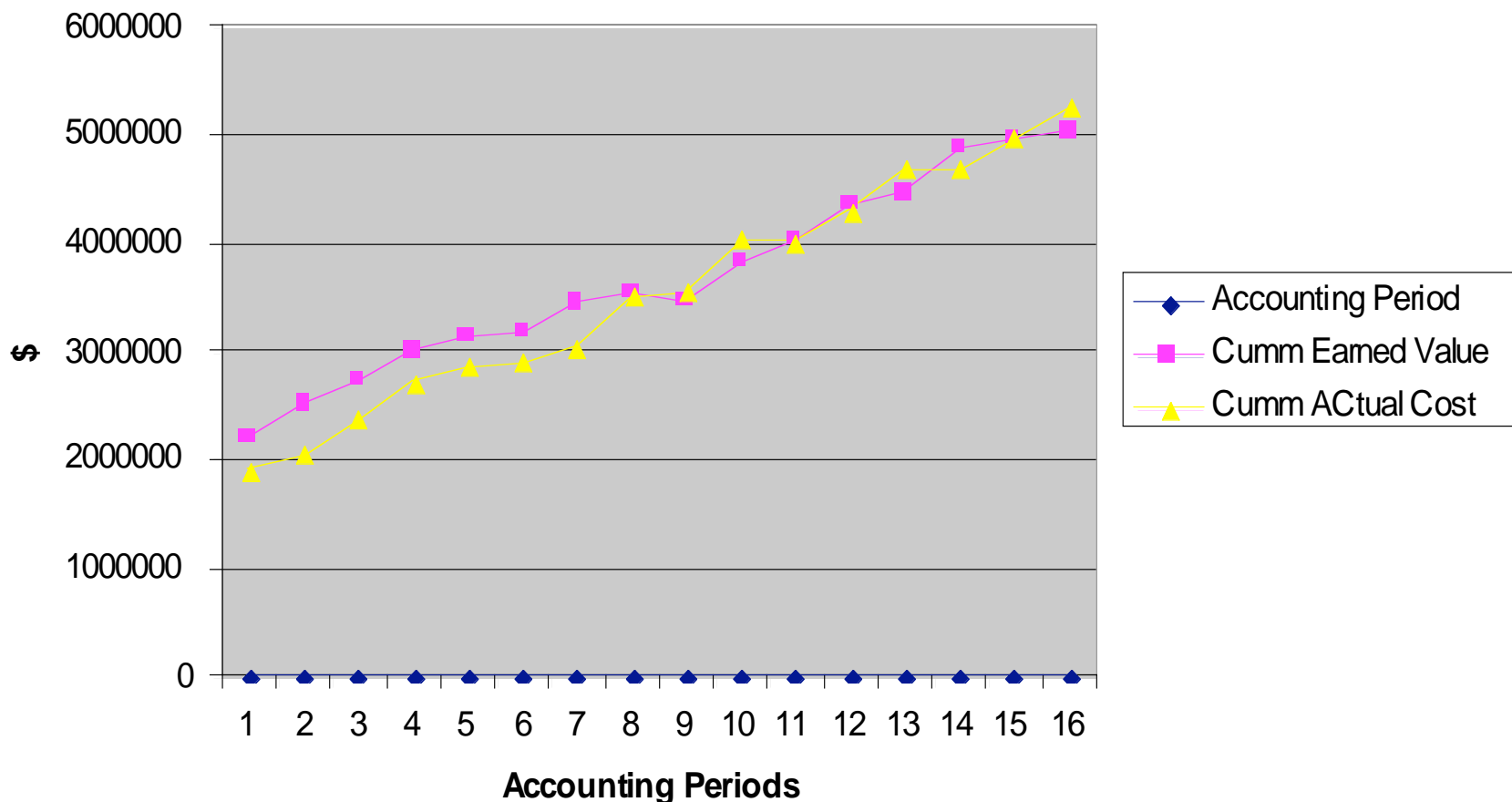
Earned Value

- Believe it or not, an earned value system can be worth the trouble.
  - Experience has shown that EV is the best EARLY indicator of trouble – that too much money is being spent for the work being accomplished.
  - EV often gets a bum wrap on religious grounds.
  - EV does not need to be elaborate or expensive to be of value.
    - Even +/- 20% accuracy is good enough to use to take corrective action.
    - Can be generated within the scheduling process, if the institutional cost accounting system can track cost against the WBS.
    - A homemade EV system can be good enough if the data is accurate and timely.
- EV is coming, like it or not, but it can be of significant help in cost performance management.

Alice Earned Value vs. Acual Costs
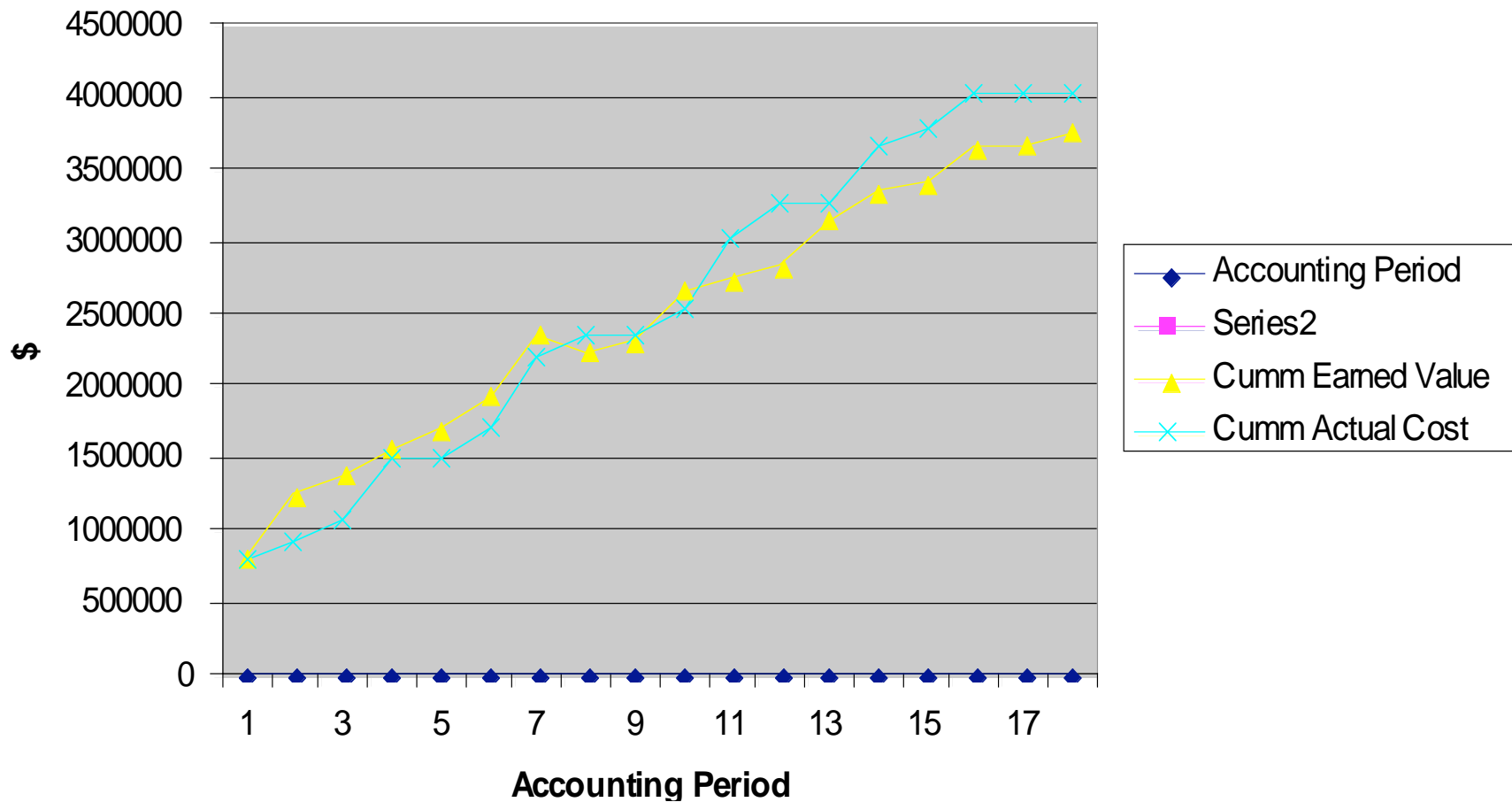
SWAP Earned Value vs. Actual Cost

Requirements Management

- Generally a top-down structured process staring with the Level 1 science requirements and mission requirements.
- Can flow all the way down to the subsystem level in a comprehensive requirements management process.
  - Requirements management is the backbone of the project's verification process.
- DOORS used extensively as a tool for management the flow down and linkages between requirements.
- Sounds easy enough – however, in practice several problems can (and did) develop that can devour resources.
  - Requirements have to written in such a way as to be verifiable!
    - Wring verifiable requirements is not a natural skill to most engineers.
    - It takes time and work to setup a requirements management process and there is nothing fun about it.

Example Flow Down – AIM Mission
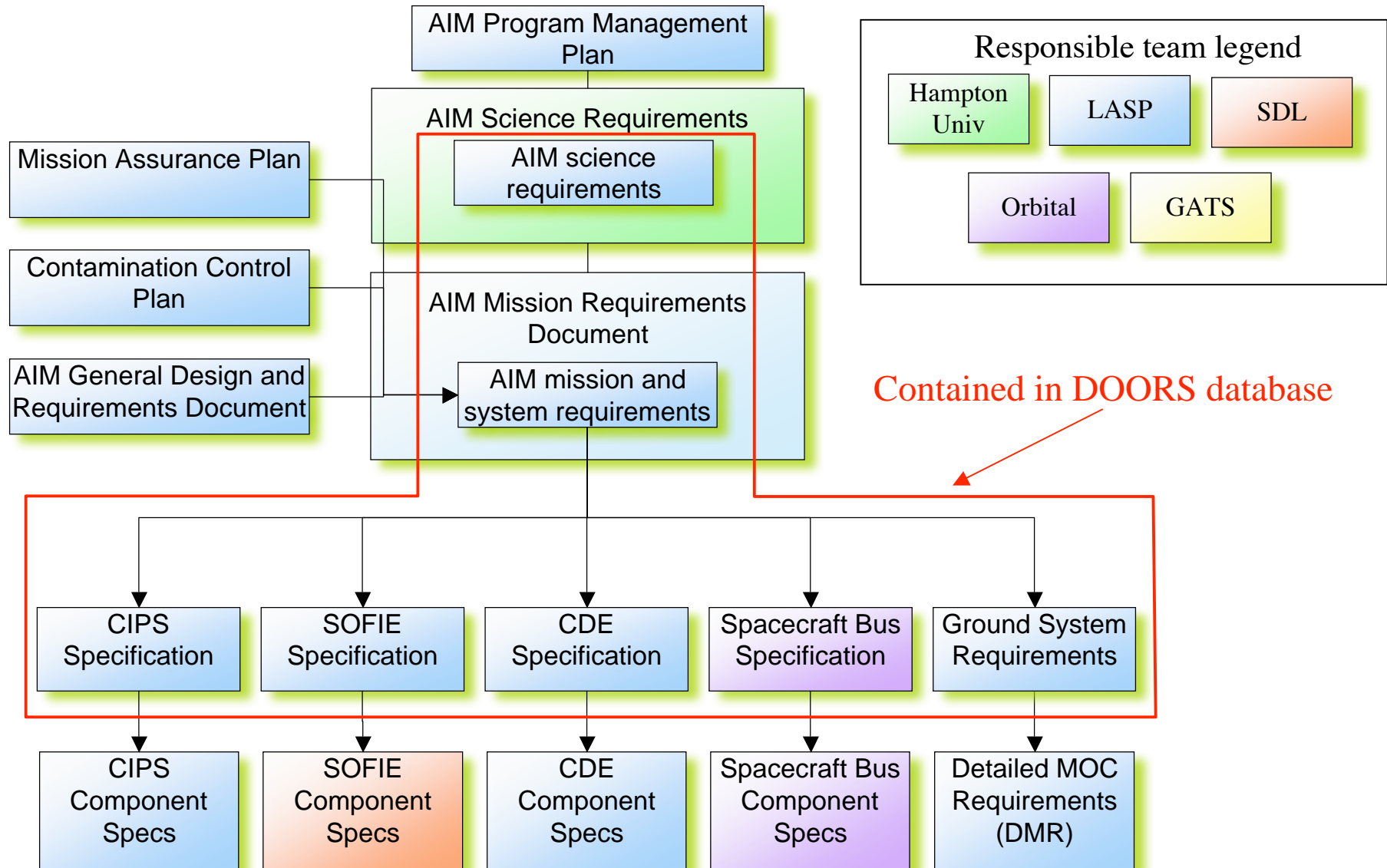
Requirements Management

- Acceptance of requirements ownership proved amazing hard.
  - Example, the spacecraft team never thought it was their job to verify instrument interface requirements.
  - Instrument teams were sure if was the spacecraft's job to verify interface protocols, cabling, labeling and marking, etc.
  - Budgeting adequate time for verification closure proved to be very hard and became a threat to maintaining the master schedule.
  - The same people needed for verification closure are probably the same people running the I&T process late in the development schedule.